Data for Pond Design Storage Calculations

Overview: The NRCS Stage Storage Computation tool in Civil 3D 2018 can extract elevation vs pool area vs volume from a surface model for use in designing a storage structure. This tool avoids errors due to islands and depressions that are not correctly handled by the built-in C3D Stage Storage tool. The results can be exported to SITES or WinPond software. Ground elevations along the centerline of the dam can be exported to WinPond for earthwork quantity estimates.
Note: Values for non-closed contours would tend to result in storage volumes that are less accurate than what is actually available.

Software: AutoCAD Civil 3D 2018, NRCS Tools, Civil 3D Workspace, NRCS C3D 2018 template, NRCS C3D Stage Computation.xlsm spreadsheet.

Prerequisite: Create a base surface for the volume comparison. E.g. Follow the instructions for *Original Ground Contours* or *LiDAR*.

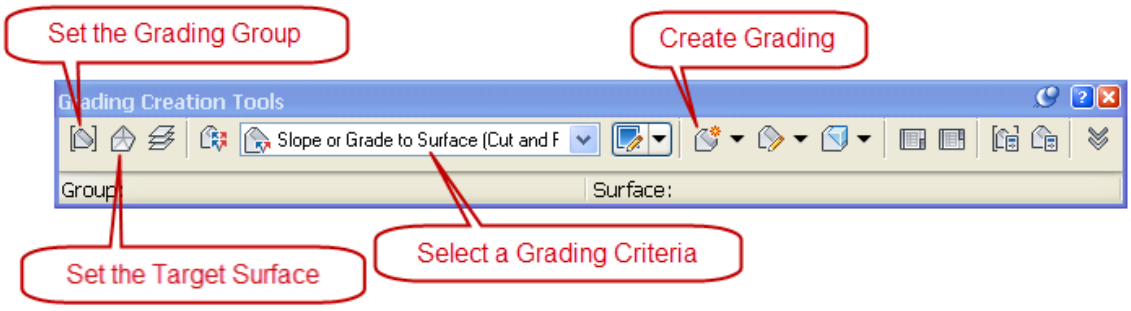
Notation: Button to Press *Displayed Text* **Icon** Action {Text to Enter} *Menu Item…*

Extracting Pool Area data to a file

In order to develop a surface that reflects the constructed storage, create an estimated upstream face of the dam.

1. Tool Palette>NRCS 11x17B… Click *Plan Commands… Embankment CL New*
2. Draw a line that represents the centerline for the embankment. This alignment can have multiple vertices. It needs to be longer than the potential embankment.
3. Click *Home… Modify… Offset*
4. Input the ½ topwidth distance to offset. E.g. {*6*} Press Enter.
5. Select the CL of Dam. Click upstream of the CL of Dam. Press Enter.
6. Click *Home… Create Design… Feature Line… Create Feature Lines from Objects…*
7. Select the upstream edge of dam. Press Enter
8. Set Site = *Storage Pond*, Checkmark *Name* and input *US edge Maximum*
9. Set Style = *_6 <Magenta>*
10. Uncheck *Erase existing entities* Checkmark *Assign Elevations* Click OK
11. Select Elevation and input the highest elev to compute. E.g. {*1094.0*} Click OK

12. Click *Home… Create Design… Grading… Grading Creating Tools…*



13. Click **Set the Grading Group**  .
14. Set the *Site* to *Storage Pond*. Click OK
15. Input a Grading Group *Name* as {*Embankment Face*} Click OK
16. Click **Set the Target Surface**  . Select *Ogrnd* (or *Ogrnd LiDAR*). Click OK
17. Pulldown **Select a Grading Criteria** 

to *Slope or Grade to Surface (Fill)*
18. Click **Create Grading.** 
19. Select the upstream edge of the embankment.
20. Click upstream of the embankment to specify the grading side.
21. Apply to entire length? Input *Y* Press Enter
22. Slope or grade? Input *S* Press Enter.
23. Fill Slope? Input *3.* Press Enter
24. Press ESC to exit the command. Close the Grading Creating tool.
25. Save the drawing.

Convert the grading to become the Embankment Face surface model.

26. Toolspace> Prospector… *Sites...Storage Pond…Grading Groups…* Right click *Embankment Face...* Click *Properties*
27. Click the *Information* tab and Checkmark the *Automatic Surface Creation*
28. In Create Surface, pulldown the *Style* to *_Contours (1 and 5) and Triangles*
29. Click OK . Click OK . Verify the surface contours
30. Select the *Embankment Face* surface. Right-Click, Click *Surface Properties..Information..* Set the Surface Style to <*off*>.

Create a storage surface model by combining the Ground and the Embankment Face.

31. Tool Palette>NRCS 11x17B… Click *Breaklines and Boundaries…Boundary Line…* 

(Ctrl + 3 to toggle on/off)
32. Draw a border snapping to the *US edge Maximum* feature line and along or inside of the border of the ground surface. Close the line by typing {C} and press Enter.
33. Toolspace> Prospector… Right-click *Surfaces... Create Surface…*
34. Input a name for the TIN surface. E.g. {Stage Storage}
35. Select a “No-smoothing” display style with contour intervals at the spacing you want to extract or smaller. Click Ok. Click Ok
36. Toolspace> Prospector… *Surfaces... Stage Storage … Definition…*Right-click *Edits… Paste Surface…*
37. Select the *Ogrnd* (or *Ogrnd LiDAR*) Surface. Click OK .
38. Toolspace> Prospector… *Surfaces... Stage Storage … Definition…*Right-click *Edits… Paste Surface…*
39. Select the *Embankment Face* Surface. Click OK . (Note: the Embankment surface must be pasted in **after** the Ground surface.)
40. In Toolspace> Prospector… *Surfaces... Stage Storage … Definition…*Right click *Boundaries*
41. Click *Add*
42. In the Add Boundaries Box set Type to *Outer* and check *Non-destructive*.
43. Click Ok and select the newly drawn boundary line object.

44. In Toolspace> Prospector… *Surfaces... Stage Storage* … Right click *Lock*

Create the Stage-Storage in using the NRCS Civil 3D Stage Storage Computation tool.

45. Click *NRCS… NRCS Dams… Stage Storage Computation…*
46. In the dialog box select the surface that you just created (e.g. *Stage Storage*).
47. Input your desired *Interval* and the *Maximum Water Elevation*
48. Set the *Minimum Water Elevation* to the first Interval above the Min Elevation shown. (e.g. if Min Elevation=842.42 & Interval=2, set the Minimum Water Elevation to 844)
49. Uncheck *Create Water Surfaces*
50. Checkmark *Include Minimum surface elevation*.
51. Click Create Volume Table.
52. Pan to an open area in the drawing and click to set a location for the stage storage table to be created.
53. Wait for the table to be created. LiDAR surfaces will take longer since they have many triangles. Once *Calculation Complete* shows up in the dialog box click Finish.

Note: If the Contour Areas display as CHK CONT (Check Contours) in the table, the user can try to eliminate that by unlocking and then raising the surface (*Stage Storage*) by 0.0001'. Then run the Stage Storage Computation again. This will eliminate the error if the contour loops back on itself, but not if it has 2 gaps.

54. Select the table. Right-click *Export* and browse to a folder.
55. Input a filename (e.g. *Jasper Stage Storage Comp 2-2-15*). Click Save.

Hide the Stage Storage grading and surface.

56. Select the *Stage Storage* surface. Right-Click, Click *Surface Properties..Information..* Set the Surface Style to *<off>*.
57. *Home… Layers… Layer Properties…*Freeze the *1.C3d.Feat.Storage Pond* and *1.C3d.Grad.Storage Pond* layers. Close the Layer Properties Manager.

Preparing Station – Elevation Data along the Centerline of Dam for WinPond

(Not needed if you do not need to compute earthwork quantities in WinPond)

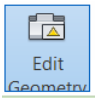
WinPond can use up to 50 station/elevation ground points. Option 1 uses Features Lines to create the data. Option 2 uses Profiles. Option 1 gives the users the ability to reduce the number of points which is especially useful with LiDAR.

Option 1 - Create a feature line along the CL of dam

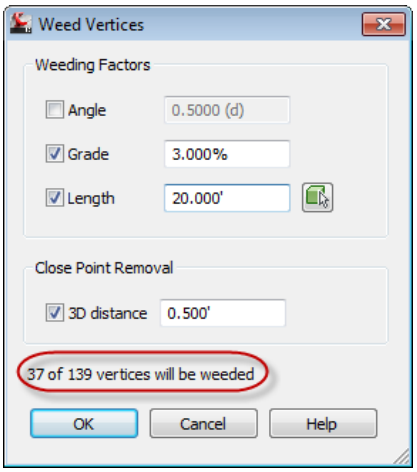
58. Click *Home… Create Design… Feature Line… Create Feature Lines from Objects…*
59. Select the centerline of dam that you had drawn earlier. Press Enter
60. Set Site = *Concrete Tank – Earthen Backfill,* (Select any unused site since you are just trying to extract data from it)
61. Checkmark *Style* and Set Style = *General Feature Line*
62. Uncheck *Erase existing entities* Checkmark *Assign Elevations* Click OK
63. In the Assign Elevation box, choose the ground surface. {*Ognd* or *Ognd LiDAR*}

64. Checkmark *Insert intermediate grade break points*. Click OK
65. Select the feature line. Look in the Properties box in the Data: *Number of Points*. If this is more than 50 you will need to Weed the feature line.

66. To Weed the number of stations, select the feature line
    a. From the *Modify* panel of the activated *Feature line* tab click *Edit Geometry* to toggle that panel on.



    b. In the *Edit Geometry* panel click *Weed Points* 
    c. Click on the feature line
    d. In the Weeding Vertices box:
        Uncheck *Angle*
        Set *Length* = 20
        Set *Grade* to 2%
        Set *3D distance* = 0.5
        Notice how many vertices will be weeded out. If the above settings don't reduce the final number of vertices to 50 or less you can increase the *Grade* upward toward 5%+. Press Tab to see the updated number of vertices.



    e. When ready to apply changes, click OK.
    f. You can repeat the process using other combinations of Grade & Length.

Option 2 – Create a profile of the Ground surface

67. Use the *Profiles & Sections* HowTo instructions following the section: *Create Alignment and Create Profile View*.

Converting Pool Area data to WinPond or SITES

68. Open the *NRCS C3D Storage Computation.xls* spreadsheet v1.09.
69. To allow Macros click Enable Content.

Import the stage storage data

70. In the **Stage Storage** tab, click Import Elev vs Area from Civil 3D.
71. Browse to the location of the .csv file. Select the NRCS C3D Volume Table export file and Click Open.
72. If you get a Clipboard message you can click No
73. Review the Elevation vs Area results to ensure you have correct information.
74. Review & update the WinPond Export default values.

Import the ground data along the CL of the dam (Optional)

75. In the **CL Cross Section** tab, click Clear Cross Section Data.
76. Option 1: From a Civil 3D Feature line
    a. In AutoCAD Civil 3D, select the *Feature line*
    b. Right-click *Elevation Editor*
    c. Right-click in the data table and click *Copy All*

   d. In the Excel spreadsheet: select the noted cell & press Ctrl + V

77. Option 2: From a Civil 3D Profile line
    a. In AutoCAD Civil 3D, go to the Profile view and select the *Profile line*
    b. Right-click *Edit Profile Geometry*
    c. Click *Profile Grid View* 
    d. Right-click in the data table and click *Copy All*
    e. In the Excel spreadsheet: select the noted cell & press Ctrl + V
78. Set the Number of decimal place for rounding of station and elevation values.

Export the data

79. Go to the **Stage Storage** tab of the spreadsheet.
80. For WinPond Projects:
    a. Click Export Data.
    b. Select *WinPond* and click Export.
    c. If CL ground data exists you will be asked whether to include it. Click Yes.
    d. Browse to the location where you want to save the WinPond project file.
    e. Input a name for the file. E.g{BC33 Dam1}
    f. Click Save. Click OK.
81. For SITES Projects:
    a. Click Export Data.
    b. Select *SITES* and click Export.
    c. Browse to the location where you want to save the tab delimited Structure data table.
    d. Input a name for the file. E.g{BC33 Dam1}
    e. Click Save. Click OK.

    Note: This file can be imported into SITES at the Structure Data Table screen by using File… Import…and browsing to the .txt file
82. For other use (comma delimited file):
    a. Click Export Data.
    b. Select *Spreadsheet (CSV file)* and click Export.
    c. Browse to the location where you want to save the comma delimited data.
    d. Input a name for the file. E.g{BC33 Dam1}
    e. Click Save. Click OK.
83. If done converting files, close the spreadsheet.